SVKM's
D. J. Sanghvi College of Engineering

Program: B.Tech in Chemical Engineering **Academic Year: 2022** **Duration: 3 hours**
Date: 10.01.2023
Time: 10:30 am to 01:30 pm
Subject: Mass Transfer Operation - I (Semester V) **Marks: 75**

Instructions: Candidates should read carefully the instructions printed on the question paper and on the cover page of the Answer Book, which is provided for their use.

(1) This question paper contains TWO pages.
(2) All Questions are Compulsory.
(3) All questions carry equal marks.
(4) Answer to each new question is to be started on a fresh page.
(5) Figures in the brackets on the right indicate full marks.
(6) Assume suitable data wherever required, but justify it.
(7) Draw the neat labelled diagrams, wherever necessary.

Question No.		Max. Marks
Q1 (a)	Calculate the amount of oxygen (A) diffused in one hour under steady state conditions through a non-diffusing gas mixture of methane (B) and hydrogen (C) in the volume ratio of 2:1. The diffusivities one estimated to be: D_{O2-H2} = 6.99×10^{-5} m2/s. D_{O2-CH4} = 1.86×10^{-5} m2/sec. The total pressure is 1×10^5 N/m2 and temperature is 0°C. The partial pressure of oxygen at two planes 2 mm apart are respectively 13000 and 6500 N/m2.	10
Q1 (b)	Explain Diffusion through polymers **OR** Diffusion in Porous Solids	5
Q2 (a)	Answer **ANY ONE** of the following: (i) A solid disc of benzoic acid 3 cm in diameter is spin at 20 rpm and 25 oC. Calculate the rate of dissolution in a large volume of water. Diffusivity of benzoic acid in water is 1.0×10^{-5} cm^2/sec, and solubility is 0.003 g/cc. The mass transfer correlation applicable is: $Sh = 0.62\ Re^{1/2}\ Sc^{1/3}$. Where, $Re = D^2\omega\rho/\mu$ and ω is the angular speed in radians/time. (For water, μ =1 cP and ρ= 1 g/cc) (ii) With schematic, explain briefly two Methods of contacting two insoluble phases, (one each of type)- Continuous Contact and Stage-wise Contact.	10
Q2 (b)	Explain Surface Renewal theory of mass transfer	5
Q3 (a)	Write short notes on **ANY TWO** of the following i) Sparged vessels ii) Venturi scrubber iii) Packed Towers	10

Q3 (b)	Write applications of spray dryer **OR** Explain Rotary drum dryer	5
Q4 (a)	Agro-industry needs to dry raw turmeric from 75 % to 4 % moisture content (wet basis), in a batch process (8 hr batch). If the requirement is 2 Ton dried product per batch, what will be the average rate of moisture removal (in kg/hr)?	5
Q4 (b)	(i) How would you apply Murphree efficiency for absorber design? Show with diagram. (ii) Explain five important solvent selection criteria for gas absorption **OR** Write a note on Absorption with Chemical Reactions	5 5
Q5 (a)	Explain analogy between heat, mass and momentum transfer	5
Q5 (b)	Answer **ANY TWO** of the following. (i) Define and explain Absolute and Relative humidity. (ii) Explain mechanical draft cooling tower in detail. (iii) What is Wet Bulb temperature? Explain its significance in cooling tower design.	10

All the Best!